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Description

This invention relates to apparatus for producing carbonated water in relatively small quantities for drinks, comprising a carbonation chamber which may be filled with water to a predetermined level such that a space is left in the chamber above the water, carbon dioxide supply means connected to said chamber for supplying carbon dioxide thereto at an elevated pressure, carbonating means to mix the carbon dioxide in intimate contact with water, and discharge means for discharging carbonated water from said chamber.

An example of such apparatus is disclosed in UK Patent 2125309. In this document, carbonation is achieved in a conventional manner by injecting carbon dioxide into the water at a low level so that the carbon dioxide bubbles upwards through the water to become absorbed therein. One disadvantage of this apparatus is that relatively high pressures, for example in the region of 170 psig (11.8 bars), have to be developed within the carbonation chamber before adequate carbonation of the water is achieved. Such pressures require that the apparatus be built with sufficient strength to withstand them and accordingly increased cost results. Further, such pressures involve safety risks.

Another disadvantage of apparatus of the type illustrated in UK Patent 2125309 is that it is difficult to achieve uniform carbonation throughout the body of water to be carbonated. For this reason, the carbonation chamber is relatively tall and of relatively narrow cross-section, this in turn requiring that the overall height of the carbonation apparatus should be relatively large.

The object of the invention is to provide an apparatus for producing carbonated water in relatively small quantities for drinks in which, at least in the preferred form of apparatus, the above-mentioned disadvantages may be alleviated.

The apparatus in accordance with the invention is characterised in that the carbonating means comprises a rotor mounted in the carbonation chamber, vane means on the rotor arranged to enter the water and the space upon rotation of the rotor with the chamber filled to said predetermined level and drive means operable to drive the rotor at a speed of at least in the region of 500 rpm.

Preferably the elevated pressure in the apparatus of the invention is in the range 60 psig (4.1 bars) to 140 psig (9.6 bars), a particularly preferred pressure being in the region of 100 psig (6.8 bars). In the preferred embodiment, the rotor has its axis horizontal positioned below the predetermined water level and is driven at a speed in the range 500 to 2000 rpm, preferably in the range 1000 to 1500 rpm.

The invention is particularly applicable for carbonating water in quantities sufficient to form a single drink and is particularly useful in the home. By way of example, the total capacity of the carbonation chamber may be about 9.5 fluid ounces (1.27 litres) and may be arranged so that the carbonation chamber is 5/6ths full when filled with water to said predetermined level. Thus, in this example, about 8 fluid ounces (approximately 1 litre) of water will be carbonated in each carbonation operation.

In the preferred embodiment, carbonation is achieved in less than 5 seconds.

Applicants acknowledge that a number of proposals have been made in the prior art for carbonation apparatus incorporating a vaned rotor rotatable about a horizontal axis. One such proposal is in US Patent 358165 (Raydt) which discloses a large factory machine in which the rotor is driven manually by a handle connected directly to the rotor shaft i.e. the drive ratio between handle and rotor is 1:1. It would thus be impossible to drive the Raydt rotor at hundreds of rpm and applicants believe that, although the Raydt disclosure indicates that rotation of the rotor can achieve carbonation in a few minutes, in fact the Raydt apparatus would not work.

A further such disclosure is in US patent 1782511 (Neuschafer) in which a vaned rotor performs oscillatory rotations about a horizontal axis and is driven via a transmission which comprises rack and pinion and reduction gearing. In this apparatus, the rotor is clearly driven at a very slow speed and serves merely to attempt to uniformly mix the carbonated water rather than to achieve carbonation itself, the latter being effected by causing carbon dioxide to bubble up through the water and by spraying water into the carbonation chamber containing a carbon dioxide atmosphere.

US Patent Nos. 1862069, 1929948 and 1929949 all in the name Kantor also disclose carbonation apparatus provided with a rotor. However, the rotor in the Kantor apparatus is operated at slow speed and functions merely to agitate the water during the introduction of CO2 into the carbonation chamber, so as to uniformly mix the carbonated water after absorption of carbon dioxide therein. Carbonation is achieved by other means, in particular the spraying of the water into the chamber together with carbon dioxide gas.

The invention is described further with reference to the accompanying drawings in which:

Fig. 1 is a diagram showing apparatus according to a preferred embodiment of the present invention;

Fig. 2 is a view in the direction of the arrow A of Fig. 1 showing a part of the apparatus;

Fig. 3 is a diagram showing how carbonation is achieved in the apparatus of Figs. 1 and 2;

Fig. 4 is a sectional view showing part of a valve unit included in the apparatus of Fig. 1, and shows the valve unit in its closed position;

Fig. 5 is a view similar to Fig. 4 but showing the valve unit in its open position;

Fig. 6 is a plan view showing part of the valve unit of Figs. 4 and 5;

Fig. 7 is a plan view similar to Fig. 6, but showing a concentrate selector element in a different position;

Fig. 8 is a block diagram illustrating a controller unit included in the apparatus of Fig. 1;

Fig. 9 is a timing chart showing the timing of

various operations performed under control of the controller unit of Fig. 8;

Fig. 10 is a flow chart illustrating in outline a programme followed by the controller unit of Fig. 8;

Fig. 11 is a view similar to Fig. 2 showing a modification to the apparatus of Fig. 1;

Fig. 12 is a view on the arrow 8 of Fig. 11;

Fig. 13 shows a further modification to the apparatus of Fig. 1;

Fig. 14 illustrates yet a further modification;

Fig. 13 is a diagram of a carbonation apparatus according to a further embodiment of the present invention;

Fig. 14 is a diagrammatic section through a carbonation chamber included in the apparatus of Fig 13;

Fig. 15 is a perspective view of a rotor included in the apparatus of Figs. 13 and 14;

Figs. 16 to 19 show a water inlet valve for the carbonation chamber of Fig. 14, in four positions;

Fig. 20 shows a section through a carbon dioxide control valve arrangement mounted on a carbon dioxide supply bottle;

Fig. 21 is a diagrammatic plan view of a valve arrangement for selecting concentrate and for discharging carbonated water from the carbonation chamber;

Figs. 22 and 23 are sections on the line A—A of Fig. 21 and show the valve arrangement in closed and opened positions respectively;

Fig. 24 is a block diagram of the circuitry included in the apparatus of Fig. 13; and

Fig. 25 is a timing diagram illustrating operation of the apparatus of Figs. 13 to 24.

With reference to Fig. 1, the carbonation apparatus comprises a carbonation chamber 10, a water supply tank 12, a carbon dioxide supply tank 14 and concentrate supply arrangement 16. A valve unit 18 is disposed on the bottom of the chamber 10 for dispensing both carbonated water from the chamber 10 and a selected concentrate from the arrangement 16 into a glass 20.

Carbonation

Water is supplied from the tank 12 to the chamber 10 through a valve V_2 controlled by a solenoid S_2, a conduit 22 and a ball valve 24 located inside the chamber 10. A vent 26 connected to the interior of the chamber 10 by means of a pipe 28 permits air in the chamber 10 to be vented to atmosphere while the chamber 10 is being filled with water. The pipe 28 projects down into the chamber 10 a distance which is such that its lower end is imersed in the water when the chamber 10 has been filled with water to the required level indicated by W.

Carbon dioxide is supplied from container 14 through valve V_1, controlled by a solenoid S_1, and a conduit 30 leading into the chamber 10 at the top.

A ball 29 located in the vent 26 is arranged to close the vent if water is forced up the pipe 28 due to pressurization of the chamber. For this purpose, the ball is movable upwardly into sealing engagement with a valve seat 31 at the top of the vent. The ball 29 is also arranged so that it closes the vent, in response to increasing gas pressure in the chamber 10, if carbon dioxide is introduced into the chamber 10 with the water level below the lower end of the pipe 28 so that carbonation may be achieved in these circumstances.

A paddle 32 is mounted inside the chamber 10 for rotation about a horizontal axis, being carried on the shaft 34 of a motor 36 which is mounted on the outside of the chamber 10. The shaft 34 may project through an opening (not shown) in the wall of the chamber 10 with an appropriate seal being provided. Alternatively, the shaft 34 could be connected to the motor 36 by a magnetic coupling.

The paddle 32 comprises three pairs of vanes 38a, 38b; 40a, 40b and 42a, 42b. The two vanes of each pair (e.g. 38a and 38b) are mounted directly opposite each other on the shaft 34. The vanes 40a and 40b are mounted on the shaft 34 to one side of the vanes 38a and 38b and at a different angle relative thereto; and the vanes 42a and 42b are mounted on the shaft 34 at the other side of the vanes 38a and 38b and again at a different angle to the other vanes. These angles are such that the six vanes are equi-angularly spaced around the shaft 34. The angler position of the shaft 34 shown in Figs. 1 and 2 is such that the vanes 38a and 38b are vertical and, as can be seen from these figures, the vane 38a projects above the water level W almost to the top of the chamber 10 whereas the vane 38b projects almost to the bottom of the chamber 10 in this position. In Fig. 2, L indicates the length of the portion of each vane which projects above the water level W when the vane is in its uppermost position with the paddle stationary and the apparatus horizontal and D indicates the diameter of the circle swept by the tip of each vane as the paddle rotates. L should be at least 6% of D and preferably greater than 12% of D. It is particularly preferred that L should be from 12% to 15% of D for achieving optimum carbonation. As the paddle 32 rotates, the the vanes move from within the water, into the space above the water level, and back into the water.

In operation, the chamber 10 is partially filled with water up to the level W. Thereafter, carbon dioxide is admitted to the space above the level of water in the chamber 10 by opening the valve V_1. A pressure switch 44 senses the gas pressure in the chamber 10. When this reaches the required level, for example 100 psig (6.8 bar), the solenoid is actuated to close the valve V_1. The ball valve 24 prevents water being forced back up the conduit 22 due to the pressure in the chamber 10. After the pressure has reached the required value, the motor 36 is energized to cause the paddle 32 to rotate. Typically, this rotation may be at a speed from 500 to 2000 rpm, preferably within the range 1000 to 1500 rpm. This rotation is continued for several seconds, for example 5 seconds, during which carbonation of the water takes place. The degree of carbonation may be varied by varying

the time for which the paddle is driven and/or by varying the pressure of the atmosphere containing carbon dioxide in the space in the chamber 10 above the water level.

The action of the paddle is to force the gas in the space above the water level down into the water. As much gas as possible should be forced into the water and it should be carried to a level which is as deep as possible. To achieve these purposes, the vanes are dimensioned, as discussed above, such that they reach nearly to the top and nearly to the bottom of the chamber 10. Also, therefore, the paddle acts to shift water from the bottom portion of the chamber 10 to a higher level so that water at all levels may be uniformly carbonated. Further, the paddle creates intense agitation of the water causing it to be splashed up into the atmosphere of carbon dioxide thereby to assist with carbonation and thereby also achieving uniform carbonation. As can be seen in Fig. 3, each vane, in addition to forcing carbon dioxide in gaseous form in front of it into the water, creates a vortex behind it which draws carbon dioxide in gaseous form in and causes the gas to be carried down into the water. Fig. 3 shows the fluid flow lines created by the vane as it moves. It can be seen from Fig. 1, that the paddle 32 is located to one side of the chamber 10, which is preferably of circular cross-section as seen in plan view. With this arrangement, the water in the chamber 10 is also caused to rotate around the chamber 10 so that, as the paddle is driven, different portions of the body of water in the chamber 10 move past the paddle to be subjected to the carbonation action.

As carbonation progresses, gas from the space above the water level in the chamber 10 is absorbed by the water so that the gas pressure reduces This is sensed by the pressure switch 44 and, when the pressure drops below a certain level, say a drop of 5 psig (0.3 bars), the valve V_1 is again opened to admit more carbon dioxide to the chamber 10.

Concentrate Dispensing

The concentrate dispensing arrangement 16 comprises three containers 46, 48 and 50 containing concentrates of different flavours. Dip tubes 52, 54 and 56 extend into the respective containers 46, 48 and 50 almost to the bottom and are connected via respective conduits 58, 60 and 62 to the valve unit 18 for supplying concentrate from the containers to the valve unit. The upper part of each of the containers 46, 48 and 50 is connected by a conduit arrangement 64 to the upper part of the chamber 10. A valve V_2 is located in the conduit arrangement 64 and is controlled by the solenoid S_2. After completion of the carbonation operation in the chamber 10, the valve V_2 is opened to permit the upper parts of the containers 46, 48 and 50 to be pressurized utilizing the gas in the upper part of the chamber 10. A pressure relief valve 66 connected to the conduit arrangement 64 limits the pressurization of the containers 46, 48 and 50 to a predetermined value, say 2 psig (0.1 bars). Thus, each of the containers 46, 48 and 50 is pressurized to the same value and this pressurization exerts a force on the concentrate in the containers which is sufficient to dispense each concentrate from its respective container. Since concentrates have different viscosities, the bore of the dip tubes 55, 54 and 56 and/or that of the conduits 58, 60, 62 is selected to ensure that the required amount of concentrate will be dispensed. Merely by way of example, if Coca Cola is to be dispensed, the bore of the dip tube and connecting conduit may be 6 mm, if lemonade is to be dispensed it may be 3 mm, if tonic is to be dispensed it may be 3 mm also.

Carbonated Water Discharge and Concentrate Selection

The valve unit 18, the details of which are illustrated in Figs. 4 to 7, provides three functions. First, it relieves the pressure in the carbonation chamber 10. Second, it permits selection of which of the concentrates from the containers 46, 48 and 50 is to be dispensed and it dispenses the selected concentrate. Third, it dispenses carbonated water from the chamber 10.

For relieving the pressure in the carbonation chamber 10, the valve unit 18 comprises an exhaust valve 68 which is connected to the upper part of the chamber 10 by a conduit 70 and part of the conduit 30. The exhaust valve 68 includes a vertically movable valve member 68a which is spring urged to its upper, closed position. An actuating lever 72 has one end 72a pivotally connected to the valve member 68a for pushing the valve member 68a downwards to open the valve 68 thereby permitting gas in the upper part of the chamber 10 to be exhausted to atmosphere through the conduits 30 and 70 and the valve 68.

The actuating lever 72 comprises an upper arm 72b and a downwardly directed arm 72c. The lever 72 is attached by a pivot 72d, intermediate the ends of the upper arm 72b, to a hollow cylindrical sleeve 74 which is mounted for vertical sliding movement in an aperture in the base 10a of the chamber 10. The sleeve 74 forms a valve for permitting discharge of carbonated water from the chamber 10 and for this purpose has got lateral openings 74a near its upper end and a head 74b which carries a seal 76 which engages the inside surface of the bottom wall 10a of the chamber 10 when the sleeve 74 is in its lower position so that at this time water cannot escape from the chamber 10.

At completion of carbonation, the chamber 10 is pressurized so that the valve head 76 is pressed firmly against the inside surface of the bottom wall 10a of the chamber 10. Consequently, if the downwardly directed arm 72c of the lever 72 is moved to the left as shown by the arrow X in Fig. 4, the lever 72 rotates about the pivot 72d, the sleeve 74 remaining stationary, so that the valve 68 is opened, thus relieving the pressure in the chamber 10. Continued movement of the arm 72c in the direction of arrow X in Fig. 4 will cause the

lever to pivot about its end 72a, so that the sleeve 74 slides upwardly to the position shown in Fig. 5, in which position the sleeve valve 74 is opened to permit carbonated water to be discharged from the chamber 10. The actuating member 72 is designed so that its lower arm 72c is arranged to be engaged by the glass 20 when placed in position so that as the glass 20 is moved to the left relative to the valve unit as seen in Figs. 4 and 5, first of all the valve 68 is opened, the sleeve 74 being held stationary by the pressure in the chamber 10, and thereafter, when the pressure in the chamber 10 has been relieved, the sleeve 74 moves upwardly to discharge carbonated water through the opening 74a and the sleeve 74 into the glass 20.

The valve unit 18 includes three concentrate dispensing valves 78, 80 and 82 connected respectively to the conduits 58, 60 and 62. The valves 78, 80 and 82, are of essentially identical construction. As seen in Figs. 4 and 5, the valve 80 comprises a vertically movable valve member 84 urged downwardly by a spring 86 to the closed position (Fig. 4). A concentrate selector bar 88 is secured to the lower end of the sleeve 74 which is rotatable about its axis (which is vertical). One end of the sleeve 88 carries a nob or finger grip 90 for effecting this rotation so as to position the opposite end 92 beneath a selected one of the valves 78, 80 or 82. Fig. 6 shows the end 92 of the bar 88 beneath the valve 80 and Fig. 7 shows it beneath the valve 82. Thus, when the sleeve 74 is raised by actuation of the lever 72 so as to discharge carbonated water into the glass 20, the selected one of the valves 78, 80 and 82 is engaged by the end 92 of the bar 88 so as to open the valve by virtue of its valve member 84 being raised. The construction of the valve member 84 is similar to that of sleeve 74 i.e. it is hollow and is provided with lateral apertures so that the selected concentrate is discharged through the selected valve member 84 and through an aperture 94 in the bar 82 and into the glass 20. As indicated above, this discharge of concentrate takes place due to the pressure introduced into the upper parts of the concentrate containers.

To avoid possible contamination of one concentrate with another, separate apertures 94 may be provided in the bar 88 for the different valves, this of course requiring appropriate positioning of the apertures and the valves 78, 80 and 82. Alternatively the aperture 94 could be sufficiently large to ensure that concentrate flows through the aperture 94 without contacting the edges thereof thus avoiding contamination: of course in this case means must be provided to ensure that the bar 88 engages the valve member 84 for the purpose of opening the associated valve. As a further alternative, the valve members 84 could have a nozzle portion which project down through the apertures 90 to ensure that the aperture 94 does not become contaminated.

Control and Timing

With reference to Fig. 8, a microprocessor controlled controller unit 100 receives power from a power supply 102 and has three inputs connected respectively to receive signals from a START button 104, the pressure switch 44 and a carbonation time selector 106. The unit 100 has outputs to the solenoids S_1 and S_2, to the motor 36 and to three indicators 108, 110 and 112 for respectively indicating that the supply of carbon dioxide gas is low, that the operator of the machine should wait and that carbonation has been completed so that a drink may be dispensed. As seen from Figs. 8 and 9, upon pressing the START button 104, the WAIT indicator 110 is switched on and the solenoid S_2 is energized to open the valve V_2 and permit water to flow from the tank 12 into the carbonation chamber 10. At the same time the valve V_3 opens but this is of no functional significance at this time. The unit 100 is arranged to maintain the valve V_2 open for a period of 5 seconds, the apparatus being designed so that during this time period the rate of flow of water into the chamber 10 is sufficient that at the end of the 5 second period the water is at the required level W. The controller 100 then de-energizes the solenoid S so as to close the valve V_2 (and also the valve V_3). The controller 100 then energizes the solenoid S_1 to open the valve V_1 and permit carbon dioxide gas to flow into the space above the water in chamber 10. The pressure in this space is continuously monitored by pressure switch 44 and the controller 100 de-energizes solenoid S_1 to close valve V_1 when the pressure reaches the required level, say 100 psig (6.8 bars). Alternatively, if the pressure has not reached this level within two seconds, the controller 100 de-energizes the solenoid S_1 to close the valve V_1 and at the same time energizes the LOW GAS indicator 108. The controller 100 then energizes the motor 36 so as to cause the water in the chamber 10 to be carbonated. The time for which the motor 36 is energized is determined by the setting of the carbonation selector 10 according to the degree of carbonation required by the user. As shown in Fig. 9, the carbonation time may vary from 2 to 5 seconds. As also shown in Fig. 9 and in Fig. 10, during the carbonation operation, the pressure switch 44 will from time to time indicate that the pressure in the upper part of chamber 10 has reduced, say by 5 psig (0.3 bars), due to absorption of carbon dioxide in the water. When this occurs, the valve V_1 is reopened until the pressure again reaches the required level, say 100 psi. This opening and closing of the valve V_1 in response to the pressure switch 44 going off and on may occur several times during the carbonation time.

At the completion of the selected carbonation time, solenoid S_2 is again energized, this time to open the valve V_3 (although the valve V_2 also opens but without any effect) so that the concentrate containers 46, 48 and 50 are pressurized utilizing the gas pressure in the chamber 10. The valve V_3 is held open for 2 seconds and is then

closed. Thereafter, the controller energizes the READY indicator 112 so that the user may now dispense a drink via the valve unit 18 as previously described.

As will be understood, the quantity of water contained in the chamber 10 is preferably that appropriate for a single drink. By way of example, therefore, the total capacity of the chamber 10 may be 9½ fluid ounces (1.27 litres) and the apparatus may be arranged so that ⅘ of this capacity is filled with water (i.e to the level W) and ⅕ of the capacity is left for containing gas. In this way, about 8 fluid ounces of carbonated water will be made and dispensed each time the machine is operated. It is possible to vary from these figures.

Modifications

Figs. 11 and 12 show a modified form of paddle. In this modification, two pairs of vanes 120a, 120b and 122a and 122b are provided. Each of the vanes is, as shown in Fig. 11, curved forwardly in the direction of rotation to assist in ensuring that the gas is efficiently driven down into the water. As seen from Fig. 12, the pair of vanes 120a and 120b is positioned to one side of the pair of vanes 122a and 122b.

Various other modifications are possible within the scope of the invention. For example, the carbonation method described may be utilized in a variety of different forms of the apparatus independently of the concentrate dispensing arrangement and the particular valve unit 18 which have been illustrated.

As examples of further modifications, it is possible to vary the timing of the operations. For example, it is possible to arrange that the motor 36 be energized before the pressure in the chamber 10 has reached the level set by the pressure switch 44. With this modification, carbonation may begin as soon as the admission of carbon dioxide to the chamber 10 starts.

As a further modification, means other than that illustrated in Figs. 4 and 6 may be provided for relieving the pressure in the chamber 10 before discharging carbonated water; or the apparatus may be constructed so that discharge of the carbonated water takes place under pressure.

Further, adjustable means, such as valves, may be provided in conduits 58, 60, 62 for controlling or varying the amount of concentrate supplied instead of providing the conduits with different bores as described.

Further Embodiment

The carbonation apparatus shown in Figs. 13 to 24 comprises a carbonation chamber 200 which is connected to a water reservoir 202 at 204. A carbon dioxide bottle 206 is connected to the chamber 200 through a valve arrangement 208 and a gas supply pipe 210. A valve 212 is mounted at the bottom of the chamber 200 for discharging carbonated water and a selected concentrate from any one of the concentrate bottles 214, 216 and 218 which are connected to the valve 212 via concentrate supply lines 220. The concentrate bottles 214, 216 and 218 may be pressurised by carbon dioxide from the chamber 200, following a carbonation operation. For this purpose, the bottles 214, 216 and 218 are connected to the chamber 200 through a gas line 222, the valve arrangement 208 and the gas line 210.

The carbonation chamber 200 contains a rotor 224, which comprises a cylindrical body 226 and six radial vanes 228. The rotor 224 is mounted for rotation about a horizontal axis and functions in the same way as the rotor 32 described with reference to Figs. 1 and 3 to drive carbon dioxide in gaseous form from a carbon dioxide atmosphere above the water level down into the water to carbonate the water. Rotor 224 is supported in a drive shaft 225 which is driven by a motor 230 mounted outside the chamber 200. The chamber 200 also contains a valve 232 for controlling the flow of water from the reservoir 202 into the chamber 200. In Fig. 14, the valve 232 is shown in the fully closed position which it assumes when the chamber 200 has been filled with water to the level W and has been pressurised, in preparation for a carbonation operation, with gas from the supply bottle 206. A seal 233 prevents water leaking along the shaft 226. L and D shown in Fig. 14 indicate the same features as in Fig. 2 and should have the same relationship.

The valve 232 comprises a cylindrical sleeve 234 which fits closely within but is movable relative to a cylindrical boss 236, a disk shaped body 238 and a downwardly projecting stem 240 which may engage the bottom of the chamber 200 to limit downward movement of the valve. A peg 242 integral with the inside of the boss 236 engages in a slot 244 in the sleeve 234. The shape of the slot 244 can be seen in Figs. 16 to 19.

Figs. 16 to 19 show the positions which the valve 232 assumes during operation of the apparatus. In Fig. 16 the valve is shown in the same position as in Fig. 14 and in this Figure it can be seen that the valve is in its uppermost position which is such that an O-ring 248 is compressed between the body 238 of the valve and the lower end surface of the boss 236 to form a gas tight seal. In this position, the peg 242 is located in the lowermost portion of the slot 244. As already stated, the valve 232 assumes the position shown in Figs. 14 and 16 when the chamber 200 is pressurised with carbon dioxde. After completion of a carbonation operation, when the chamber 200 is depressurised, the weight of water on the valve 232 causes it to move downwardly from the position shown in Fig. 16 to that shown in Fig. 17 in which a horizontal abutment 248 provided in the wall of the slot 244 rests on the peg 242 and thus prevents further downward movement of the valve 232. In the position shown in Fig. 17 the valve is still closed so that water is prevented from entering the chamber 200 from the reservoir 202 (although it should be understood that a small amount of leakage may arise). The valve may be opened by rotating it about a

vertical axis from the position shown in Fig. 17 to that shown in Fig. 18 in which the abutment surface 248 is clear of the peg 242. This rotation is achieved by causing the rotor 224 to be momentarily rotated so that a portion 228a of one of the vanes 228 engages a further peg 248 projecting from the side of the disk shaped body 238. This engagement is shown in Fig. 18. After the valve 232 has been rotated to the position shown in Fig. 18, it may fall further under the weight of water until the stem 240 engages the bottom of the chamber 200 as shown in Fig. 19. In this position, the slot 244 and further slots 250 in the sleeve 234 are located below the boss 236 so that water may flow into the chamber 200 through these slots.

As the water approaches the level W, the valve 232 is caused to float upwardly until it returns to the position shown in Fig. 18 at which time the water supply is again cut off. Thereafter, carbon dioxide under pressure is introduced into the chamber 200 and the valve 232 is forced back to the position shown in Fig. 16. During its movement from the position shown in Fig. 18 to that shown in Fig. 16, an inclined surface 252 in the slot 244 engages the peg 242, thereby causing the valve 232 to rotate so that the peg 242 is again located in the lowest part of the slot 244 which, as shown in Fig. 16, is below the abutment 48 surface 2.

The valve arrangement 208 is novel and is shown in more detail in Fig. 20. It comprises a body 252 having a cap arrangement 254 which is secured by conventional means (not shown) such as screw threads to the carbon dioxide bottle 206. A conventional means (not shown) is provided to enable the valve arrangement 208 to be connected to the bottle 206 to put the interior of the bottle 206 into communication with the valve arrangement 208 without significant loss of carbon dioxide gas when the connection is made.

The body 252 contains a passage 256 which communicates via a valve 258 with the interior of the bottle 206. The gas supply pipe 210 is connected to the passage 256 so that when the valve 258 is opened carbon dioxide gas from the bottle 206 may be supplied to the carbonation chamber 200. The passage 256 is also connected via a passage 260 and a pipe 262 to a pressure sensing chamber 264 one wall of which is constituted by a diaphragm 266. A solenoid 268 has its coil 274 secured to a rod 270 of which the lower end engages the upper surface of the diaphragm 266 and which is biassed downwardly by a compression spring 272. The armature (not shown) of the solenoid 268 is connected by a rod 276 to one end 278 of a lever 280. The opposite end of the lever 280 is connected by a pivot 282 to a stem 284 of a valve 286 which is located in the body 260 to place the gas pipes 210 and 222 in communication with each other when open. The valve 258 has a stem 288 which abuts the lever 280 at a position intermediate its ends. A pressure sensitive switch, constituted by electrical contacts 290 diagrammatically shown in Fig. 20, is provided so as to give an electrical signal in response to the pressure in the chambers 264 reaching a value which is sufficiently high to raise the diaphragm 266.

The valve arrangement 208 is such that when the solenoid 268 is energized, the rod 276 is drawn downwardly to cause the lever 280 to pivot about the pivot 282 thereby opening the valve 258 to permit carbon dioxide gas to be supplied to the carbonation chamber. The strength of the spring 272 is such as to ensure that when the solenoid is energized the rod 276 is drawn downwardly rather than the rod 270 being drawn upwardly against the force of the spring 272. The pressure in the carbonation chamber 200 is sensed by the diaphragm 266 and when this pressure has reached a level sufficient for the carbonation operation to begin, for example 100 psig (6.8 bars), the diaphragm 266 is raised. Also the pressure sensitive switch 290 opens to give a signal indicating that the required pressure level has been reached. The upward movement of the diaphragm 266 raises the whole of the solenoid 268 so that the lever 280 is pivoted upwardly about the pivot 282 and the valve 258 closes under the action of the gas pressure in the bottle 206 and the force of the stem 288 against the lever 280 holds the valve 286 in its closed position. The carbonation operation may now begin and, as carbon dioxide is absorbed into the water in the carbonation chamber 200, the pressure in the chamber 200 will decrease to some extent, permitting the diaphragm 266 to move downwardly so that the valve 258 is again opened. A balanced condition will be reached at which the valve 258 is just sufficiently open to maintain the required pressure in the carbonation chamber 200 during the carbonation operation.

After carbonation has been completed, the solenoid 268 is de-energized. Thereafter, the pressure in the carbonation chamber 200, the gas supply pipe 210 and the passage 256 is sufficient to open the valve 286 so as to pressurize the concentrate supply containers 214, 216, 218. A pressure relief valve (not shown) limits the pressure in the containers 214, 216 and 218 to about 2 psig (0.1 bars). Valve 286 acts as a non-return valve ensuring pressure in the containers 214, 216 and 218 is not lost when the chamber 200 is emptied.

The valve arrangement 208 is particularly simple and economic to construct and therefore advantageous, particularly as only single solenoid is needed.

As with the previously described embodiments, carbonation is achieved in the embodiment under description by causing the rotor 224 to be driven so that the vanes or blades 228 move continuously and repeatedly between the water in the chamber 200 and the carbon dioxide atmosphere which is formed above the water so as to drive carbon dioxide from the atmosphere down into the water. Actuation of the motor 230

to start the carbonation operation is achieved in response to the signals from the pressure sensitive switch 290.

Discharge of carbonated water from the carbonation chamber 200 and selection of the desired concentrate from the containers 214, 216 and 218 is achieved by the valve 212 which is shown in more detail in Figs. 21 to 23.

The valve 212 comprises a housing 300 which is secured to the underside of the carbonation chamber 200 and includes a sleeve 302 in which a cylindrical valve member 304 is mounted for vertical sliding movement. A valve head 306 is secured to the top of the cylindrical valve member 304 and engages the inside surface of the bottom of the chamber 200 when in the closed position to prevent discharge of water from the chamber 200, this position being shown in Fig. 22. As shown in Fig. 23, the valve member 304 may be raised to its open position in which water may be discharged from the chamber 200 by passing through apertures 308 and then downwardly through the interior of the cylindrical valve member 304, exiting via the open bottom end of member 304.

An actuating lever 310 is pivotable as shown in Fig. 23 for raising the valve member 304 to the open position. The lever 310 is located in position by a spindle 312 projecting downwardly from the valve head 306 through an aperture 314 in the lever 310. The aperture 314 is sufficiently large relative to the spindle 312 to permit the pivoting movement of the lever 310. An inner arcuate wall 316 provided in the housing 300 acts as fulcrum for the pivoting movement of the lever 310, this pivoting movement being achieved by the operator pressing down on the outer end portion 310a of the lever 310. The lever 310 is rotatable in a horizontal plane about the spindle 312 and can be pivoted to the position shown in Fig. 23 at any one of three positions defined by recesses 318 provided in an outer arcuate wall 320 of the housing 300, the outer arcuate wall 320 preventing the pivotal movement of the lever shown in Fig. 23 unless it is in register with one of the recesses 318. Stability is provided to the lever 310 by upwardly and downwardly directed arcuate projections 313 and 315 which respectively engage the outer surface of the sleeve 302 and the inner surface of the arcuate wall 316.

When the lever 310 is in one of the positions defined by the recesses 318, its inner end 310b engages a respective one of three concentrate selector valves 322 so that when the lever 310 is pivoted as shown in Fig. 23, the corresponding selector valve 322 is opened against a corresponding spring 324 to permit the corresponding concentrate to flow into the interior of the housing 300 via the corresponding conduit 220 and a corresponding boss 236 associated with the valve 322 for mixing with the carbonated water, the concentrate and the carbonated water falling from the valve arrangement 212 into an appropriate vessel such as a glass 215 (Fig. 13). The concentrate selector and valve arrangement illustrated in Figs. 20 to 23 is particularly simple and inexpensive to manufacture and has the advantage that the carbonated water tends to wash the valves 322 and their surroundings so that an undesirable build up of stale concentrate may be avoided.

The embodiment under discussion includes a simplified control arrangement which will be described with reference to Figs. 24 and 25. The control arrangement comprises a control circuit 400 having as inputs a start button 402, a stop button 404 and the pressure switch 290. The control circuit 400 has four outputs connected respectively to the solenoid 268, the motor 230, an indication lamp 406 mounted on the exterior of the apparatus and a low pressure indicator 408 also mounted on the exterior of the apparatus.

As can be seen from Fig. 23, when the start button 402 is pressed, the motor 230 is momentarily energized to cause the rotor 224 to rotate so that the vane portion 228a engages the peg 248 to open the valve 232 and permit water to enter the carbonation chamber 200. The apparatus is constructed so that water flows into the carbonation chamber at a rate which is such that it reaches the required level W by the end of a five second period, this period being timed by the control circuit 400. At the end of this period, the control circuit 400 supplies a signal which causes the solenoid 268 to be turned on to supply carbon dioxide to the carbonation chamber via the valve 268. After a short period, the carbonation chamber reaches the required pressure and in response to this a signal is supplied by the pressure switch 290 to the control circuit 400 which turns the motor 230 on to begin the carbonation operation. If the required pressure is not reached within a predetermined time, the control circuit activates the low pressure indicator 408. The carbonation operation can continue for a maximum period of five seconds which period is timed by the control circuit 400 and begins with the signal from the pressure switch 290. The apparatus is arranged so that the maximum desired degree of carbonation is achieved by the end of the five second period. If, however, the user desires a lower level of carbonation, he can terminate the carbonation operation at any time by pressing the stop button. To assist the operator in determining when to stop the carbonation operation, when he desires a lower level of carbonation, the control circuit 400 causes the indication lamp 406 to flash at intervals during the five second period in which carbonation is taking place. Thus, by counting the number of flashes, the user will have an idea of the level of carbonation achieved. Fig. 25 illustrates an operation in which carbonation was determinated after two flashes of the indication lamp. After the end of the five second carbonation period, the circuit 400 turns the indication lamp on for a period to indicate that carbonation is complete. When the carbonation operation stops, either in response to actuation of the stop button 404 or in response to completion of the five second carbonation period, the circuit 400 de-energizes the solenoid 268 and

motor 230. The concentrate containers are then pressurized as previously described and the operator may rotate the lever 310 to the position required to select the concentrate which he wishes to use and then depresses the lever to discharge the carbonated water and the selected concentrate. Of course, if desired, a further recess 318 may be provided in the arcuate wall 320 to permit the operator to discharge carbonated water without any concentrate.

Thus it will be appreciated that the embodiment described with reference to Figs. 13 to 25 is rather simpler than the earlier described embodiment and may be manufactured more economically. The various numerical data given in connection with the earlier embodiment for speed of rotation of the rotor, gas pressures, etc., may be all applied to the embodiment of Figs. 13 to 25.

Claims

1. Apparatus for producing carbonated water in relatively small quantities for drinks, comprising a carbonation chamber (10; 200) which may be filled with water to a predetermined level (W) such that a space is left in the chamber (10; 200) above the water, carbon dioxide supply means (14, 100; 206, 400) connected to said chamber (10; 200) for supplying carbon dioxide thereto at an elevated pressure, carbonating means to mix the carbon dioxide in intimate contact with water, and discharge means (18; 212) for discharging carbonated water from said chamber (10; 200), characterised in that said carbonating means comprises a rotor (32; 224) mounted in said carbonation chamber (10; 200), vane means (38, 40, 42; 120, 122, 228) on said rotor (32; 224) arranged to enter the water and said space upon rotation of the rotor (32; 224) with the chamber (10; 200) filled to said predetermined level (W), and drive means (36; 230) operable to drive said rotor (32; 224) at a speed of at least in the region of 500 rpm.

2. Apparatus according to claim 1, characterised by water supply means (12, V2; 202, 204) for supplying water to said chamber (10; 200) and control means (100; 232) for automatically controlling the water supply means to fill said chamber (10; 200) to said level (W).

3. Apparatus according to claim 2, characterised in that said control means (100) causes said water supply means (12, V2) to supply water to said chamber for a preselected time period whereby said chamber (10) is filled to said level (W).

4. Apparatus according to claim 2, characterised in that said water supply means comprises a reservoir (202) connected to said chamber (200) for supplying water thereto and said control means comprises a valve (232) for controlling the supply of water from said reservoir (202) to said chamber (200), said valve (232) being arranged to be opened by a momentary movement of said rotor (224) and to close in response to the level of water in the chamber (200).

5. Apparatus according to claim 4, characterised in that said valve (232) is arranged to be engaged by the vane means (228) thereby to be opened by said momentary movement of said rotor (224) and is further arranged to float on water in said chamber (200) thereby to close in response to the water level.

6. Apparatus according to any preceding claim, characterised by concentrate supply means (16; 214) for concentrated flavouring, and means (64; V3; 222, 286) for discharging concentrate from said concentrate supply means (16; 214) for mixing with said carbonated water.

7. Apparatus according to claim 6, characterised in that said means (V3, 64; 286, 222) for discharging concentrate is operable to supply carbon dioxide to said concentration supply means (16; 214) to cause said discharge of concentrate.

8. Apparatus according to claim 7, characterised in that said means (64, V3; 222, 286) for discharging concentrate is operable to obtain carbon dioxide for supply to the concentrate supply means (16, 214) from the carbonation chamber (10; 200) after completion of a carbonation operation.

9. Apparatus according to any preceding claim, characterised in that said rotor (32; 224) has its axis substantially horizontal.

10. Apparatus according to claim 9 as dependent upon any of claims 2 to 5, characterised in that the axis of the rotor (32; 221) is below said level (W).

11. Apparatus according to claim 9 or 10, characterised in that if D is the diameter of the circle swept by the tip of the vane means upon rotation of the rotor and L is the length of the portion of the vane means projecting above the water level (W) with the rotor stationary, the vane means in its uppermost position and the apparatus horizontal, L is at least 5 percent of D.

12. Apparatus according to claim 11, characterised in that L is at least 12 percent of D.

13. Apparatus according to claim 11, characterised in L is from 12 percent to 15 percent of D.

14. Apparatus according to any preceding claim characterised in that said vane means (38; 228) comprises a plurality of vanes.

15. Apparatus according to any preceding claim, characterised by means (100; 400) to vary the time for which said drive means (36; 230) is actuated, to vary the degree of carbonation achieved.

16. Apparatus according to any preceding claim, characterised by means (100; 400) for automatically terminating the operation of said drive means (36; 230) after a predetermined time.

17. Apparatus according to claim 16, characterised by manually operable stop means (404) for terminating the operation of said drive means (36; 230) before the end of said predetermined time.

18. Apparatus according to claim 16, characterised by means (106) for selecting one of a plurality of different said predetermined times, for selecting the degree of carbonation achieved.

19. Apparatus according to any preceding claim, characterised by means (44; 290) for controlling the pressure of said carbon dioxide in said space to be within a range 60 psig (4.1 bars) to 140 psig (9.6 bars).

20. Apparatus according to claim 19, characterised in that said pressure control means (44; 290) is operative to maintain said pressure at approximately 100 psig (6.8 bars).

21. Apparatus according to any preceding claim, characterised in that operation of said drive means (36; 230) for a period of no more than five seconds achieves carbonation.

22. Apparatus according to any preceding claim, characterised that said drive means (36; 230) is operable to rotate said rotor (32; 224) at at least 1,000 rpm.

23. Apparatus according to claim 22, characterised in that said drive means (36; 230) is operable to rotate said rotor (32; 224) at from 1,000 to 1,500 rpm.

24. Apparatus according to any of claims 1 to 21, characterised in that said drive means (36; 230) is operable to rotate said rotor (32; 224) at from 500 to 2,000 rpm.

25. Apparatus according to any preceding claim, characterised in that said carbonation chamber (10; 200) contains not more than about 1 litre (about 8 fluid ounces) when filled to said level (W).

26. Apparatus according to any preceding claim, characterised in that said carbonation chamber (10; 200) is filled to about five sixths of its capacity when filled to said level (W).

27. Apparatus according to any of claims 2 to 6 or any claim as dependent thereon, characterised by cycle control means (100; 400) operable in response to a start signal to cause said apparatus to perform a carbonation cycle in which said water supply means (12, V2; 202, 204) supplies water to fill said chamber (10; 200) to said predetermined level (W) with said chamber (10; 200) unpressurised and thereafter said carbon dioxide supply means (14; 206) is caused to supply carbon dioxide to said chamber (10; 200) to fill said space at said elevated pressure, said cycle control means (100; 400) also actuating said drive means (36; 230) to cause said rotor (32; 224) to be driven at said speed to effect carbonation.

28. Apparatus according to claim 27, characterised in that said cycle control means (100; 400) activates said drive means (36; 230) to begin carbonation after said space has been filled with carbon dioxide to said elevated pressure.

29. Apparatus according to any of claims 6 to 8 and according to claim 28, characterised in that said cycle control means (100; 400) is further operable to activate said means (64, V3; 222, 298) for discharging concentrate after completion of carbonation.

30. Apparatus according to any preceding claim, characterised in that said rotor (32; 224) is disposed eccentrically in said carbonation chamber (10; 200).

Patentansprüche

1. Vorrichtung zur Herstellung von kohlensäurehaltigem Wasser in relativ kleinen Mengen für Getränke, mit einer Kammer zum Versetzen mit Kohlensäure (10; 200), die mit Wasser bis zu einem bestimmten Wasserstand (W) gefüllt werden kann, so daß ein Raum in der Kammer (10; 200) oberhalb des Wassers freibleibt, einer Kohlendioxid-Zufuhreinrichtung (14, 100; 206, 400), die mit der Kammer (10; 200) verbunden ist, um dieser Kohlendioxid unter erhöhtem Druck zuzuführen, einer Einrichtung zum Versetzen mit Kohlensäure, um das Kohlendioxid in engem Kontakt mit dem Wasser zu vermischen, und einer Abgabeeinrichtung (18; 212) zum Abgeben des mit Kohlensäure versetzten Wassers aus der Kammer (10; 200), dadurch gekennzeichnet, daß die Einrichtung zum Versetzen mit Kohlensäure einen Rotor (32; 224) aufweist, der in der Kammer (10; 200) zum Versetzen mit Kohlensäure angebracht ist, eine Schaufeleinrichtung (38, 40, 42; 120, 122, 226) am Rotor (32; 224), die so angeordnet ist, daß sie in das Wasser und in den Raum infolge der Drehung des Rotors (32; 224) eintritt, wobei die Kammer (10; 200) bis zum vorbestimmten Wasserstand (W) gefüllt ist, und eine Antriebseinrichtung (36; 230), die zum Antreiben des Rotors (32; 224) mit einer Drehzahl betreibbar ist, die mindestens im Bereich von 500 U/min liegt.

2. Vorrichtung nach Anspruch 1, gekennzeichnet durch eine Wasser-Zufuhreinrichtung (12, V2; 202, 204) zum Zuführen von Wasser zur Kammer (10; 200), und eine Steuereinrichtung (10; 232) zum automatischen Steuern der Wasser-Zufuhreinrichtung zum Füllen der Kammer (10; 200) bis zum genannten Wasserstand (W).

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Steuereinrichtung (100) die Wasser-Zufuhreinrichtung (12, V2) veranlaßt, Wasser in die Kammer während eines vorgewählten Zeitraumes einzuspeisen, wodurch die Kammer (10) bis zum genannten Wasserstand (W) gefüllt wird.

4. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Wasser-Zufuhreinrichtung einen Vorratsbehälter (202) aufweist, der mit der Kammer (200) verbunden ist, um dieser Wasser zuzuführen, und daß die Steuereinrichtung ein Ventil (232) zum Steuern der Zufuhr des Wassers aus dem Vorratsbehälter (202) zur Kammer (200) aufweist, wobei das Ventil (232) so angeordnet ist, daß es durch eine kurzzeitige Bewegung des Rotors (224) öffnet und in Abhängigkeit vom Wasserstand des Wassers in der Kammer (200) schließt.

5. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß das Ventil (232) zum Eingriff mit der Schaufeleinrichtung (226) eingerichtet ist, um hierdurch durch die kurzzeitige Bewegung des Rotors (224) geöffnet zu werden, und ferner so angeordnet ist, daß es auf dem Wasser in der Kammer (200) aufschwimmt, um in Abhängigkeit vom Wasserstand des Wassers zu schließen.

6. Vorrichtung nach jedem vorangehenden Anspruch, gekennzeichnet durch eine Konzentrat-Zufuhreinrichtung (16; 214) für konzentrierte Geschmacksstoffe, und eine Einrichtung (84; V3; 222, 286) zum Abgeben von Konzentrat aus der Konzentrat-Zufuhreinrichtung (16; 214) zur Vermischung mit dem mit Kohlensäure versetzten Wasser.

7. Vorrichtung nach Anspruch 6, dadurch gekennzeichnet, daß die Einrichtung (V3, 84; 286, 222) zum Abgeben des Konzentrats betreibbar ist, um Kohlendioxid zu der Konzentrations-Zufuhreinrichtung (16; 214) zuzuführen, um die Abgabe des Konzentrats zu veranlassen.

8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß die Einrichtung (84, V3; 222, 286) zum Abgeben des Konzentrats betreibbar ist, um Kohlendioxid zur Zufuhr an die Konzentrat-Zufuhreinrichtung (16, 214) aus der Kammer (10; 200) zum Versetzen mit Kohlensäure nach Fertigstellung eines Vorgangs des Versetzens mit Kohlensäure zu erhalten.

9. Vorrichtung nach jedem vorangehenden Anspruch, dadurch gekennzeichnet, daß der Rotor (32; 224) seine Achse im wesentlichen horizontal aufweist.

10. Vorrichtung nach Anspruch 9, soweit abhängig von jedem der Ansprüche 2 bis 6, dadurch gekennzeichnet, daß die Achse des Rotors (32; 221) unter dem genannten Wasserstand (W) liegt.

11. Vorrichtung nach Anspruch 9 oder 10, dadurch gekennzeichnet, daß dann, wenn D der Durchmesser des Kreises ist, der von der Spitze der Schaufeleinrichtung infolge der Drehung des Rotors beschrieben wird, und L die Länge des Abschnitts der Schaufeleinrichtung ist, die über den Wasserspiegel (W) des Wassers bei ruhendem Rotor übersteht, wobei sich die Schaufeleinrichtung in ihrer obersten Lage und die Vorrichtung horizontal befindet, L mindestens 5% von D ist.

12. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, daß L mindestens 12% von D ist.

13. Vorrichtung nach Anspruch 11, dadurch gekennzeichnet, daß L von 12% bis 15% von D ist.

14. Vorrichtung nach jedem vorangehenden Anspruch, dadurch gekennzeichnet, daß die Schaufeleinrichtung (38; 228) mehrere Schaufeln aufweist.

15. Vorrichtung nach jedem vorangehenden Anspruch, gekennzeichnet durch eine Einrichtung (100; 400) zum Ändern der Zeit, während welcher die Antriebseinrichtung (36; 230) betätigt wird, um das Maß der erreichten Versetzung mit Kohlensäure zu variieren.

16. Vorrichtung nach jedem vorangehenden Anspruch, gekennzeichnet durch eine Einrichtung (100; 400) zum automatischen Beenden des Betriebes der Antriebseinrichtung (36; 230) nach einer vorbestimmten Zeit.

17. Vorrichtung nach Anspruch 16, gekennzeichnet durch eine von Hand betätigbare Stoppeinrichtung (404) zum Beenden des Betriebes der Antriebseinrichtung (36; 230) vor dem Ende der vorbestimmten Zeit.

18. Vorrichtung nach Anspruch 16, gekennzeichnet durch eine Einrichtung (106) zum Auswählen einer aus einer Anzahl unterschiedlicher vorbestimmter Zeiten, um das Maß der erreichten Versetzung mit Kohlensäure zu wählen.

19. Vorrichtung nach jedem vorangehenden Anspruch, gekennzeichnet durch eine Einrichtung (44; 290) zum Steuern des Druckes des Kohlendioxids im Raum, so daß er innerhalb eines Bereiches von 60 psig (4,1 bar) bis 140 psig (9,6 bar) liegt.

20. Vorrichtung nach Anspruch 19, dadurch gekennzeichnet, daß die Drucksteuereinrichtung (99; 290) wirksam ist, um den Druck bei etwa 100 psig (6,8 bar) zu halten.

21. Vorrichtung nach jedem vorangehenden Anspruch, dadurch gekennzeichnet, daß der Betrieb der Antriebseinrichtung (36; 230) während eines Zeitraums von nicht mehr als 5 Sekunden des Versetzen mit Kohlensäure erreicht.

22. Vorrichtung nach jedem vorangehenden Anspruch, dadurch gekennzeichnet, daß die Antriebseinrichtung (36; 230) zum Drehen des Rotors (32; 224) mit mindestens 1000 U/min betreibbar ist.

23. Vorrichtung nach Anspruch 22, dadurch gekennzeichnet, daß die Antriebseinrichtung (36; 230) zum Drehen des Rotors (32; 224) mit von 1000 bis 1500 U/min betreibbar ist.

24. Vorrichtung nach jedem der Ansprüche 1 bis 21, dadurch gekennzeichnet, daß die Antriebseinrichtung (36; 230) zur Drehung des Rotors (32; 224) mit von 500 bis 2000 U/min betreibbar ist.

25. Vorrichtung nach jedem vorangehenden Anspruch, dadurch gekennzeichnet, daß die Kammer (10; 200) zum Versetzen mit Kohlensäure nicht mehr als etwa 1 l (etwa 8 fluid ounces) enthält, wenn sie bis zum genannten Wasserstand (W) gefüllt ist.

26. Vorrichtung nach jedem vorangehenden Anspruch, dadurch gekennzeichnet, daß die Kammer (10; 200) zum Versetzen mit Kohlensäure bis zu etwa 5/6 ihrer Kapazität gefüllt ist, wenn sie bis zum genannten Wasserstand (W) gefüllt ist.

27. Vorrichtung nach jedem der Ansprüche 2 bis 5 oder jedem Anspruch, soweit er hiervon abhängig ist, gekennzeichnet durch eine Zyklus-Steuereinrichtung (100; 400), die in Abhängigkeit von einem Startsignal betreibbar ist, um die Vorrichtung zu veranlassen, einen Zyklus des Versetzens mit Kohlensäure durchzuführen, bei dem die Wasser-Zufuhreinrichtung (12, V2; 202, 204) Wasser zuführt, um die Kammer (10; 200) bis zum vorbestimmten Wasserstand (W) zu füllen, wobei die Kammer (10; 200) nicht unter Druck steht, und nachfolgend die Kohlendioxid-Zufuhreinrichtung (14; 206) veranlaßt wird, Kohlendioxid der Kammer (10; 200) zuzuführen, um den Raum mit dem genannten erhöhten Druck zu füllen, wobei die Zyklus-Steuereinrichtung (100; 400) auch die Antriebseinrichtung (36; 230) betätigt, um den Rotor (32; 224) zu veranlassen, bei der genannten Drehzahl angetrieben zu werden, um das Versetzen mit Kohlensäure zu bewirken.

28. Vorrichtung nach Anspruch 27, dadurch gekennzeichnet, daß die Zyklus-Steuereinrichtung (100; 400) die Antriebseinrichtung (36; 230) akti-

viert, um das Versetzen mit Kohlensäure zu beginnen, nachdem der Raum mit Kohlendioxid bis zum genannten erhöhten Druck gefüllt wurde.

29. Vorrichtung nach jedem der Ansprüche 6 bis 8 und nach Anspruch 28, dadurch gekennzeichnet, daß die Zyklus-Steuereinrichtung (100; 400) ferner zum Aktivieren der Einrichtung (64, V3; 222, 286) betreibbar ist, um das Konzentrat nach Fertigstellung des Versetzens mit Kohlensäure abzugeben.

30. Vorrichtung nach jedem vorangehenden Anspruch, dadurch gekennzeichnet, daß der Rotor (32; 224) exzentrisch in der Kammer (10; 200) zum Versetzen mit Kohlensäure angeordnet ist.

Revendications

1. Dispositif de production d'eau gazeuse en quantité relativement petite pour boissons, comprenant une chambre de saturation à gaz carbonique (gazéification) (10, 200) pouvant être remplie d'eau jusqu'à un niveau prédéterminé (W) de façon qu'un espace soit laissé libre dans la chambre (10, 200) au-dessus de l'eau, des moyens d'alimentation en gaz carbonique (14, 100; 206, 400) reliés à la chambre (10, 200) pour fournir du gaz carbonique à celle-ci sous une pression élevée, des moyens de saturation à gaz carbonique pour mélanger intimement le gaz carbonique à l'eau, et des moyens de décharge (18, 212) pour décharger l'eau carbonatée de la chambre (10, 200), dispositif caractérisé en ce que les moyens de saturation comprennent un rotor (32, 224) monté dans la chambre (10, 200), des moyens de palettes (38, 40, 42; 120, 122, 228) montées sur le rotor (32, 224) pour pénétrer dans l'eau et dans l'espace situé au-dessus de l'eau lorsqu'on fait tourner le rotor (32, 224) et lorsque la chambre (10, 200) est remplie jusqu'au niveau prédéterminé (W), et des moyens d'entraînement (36, 230) servant à entraîner le rotor (32, 224) à une vitesse se situant au moins dans la zone de 500 tours/minute.

2. Dispositif selon la revendication 1, caractérisé en ce qu'il comprend des moyens d'alimentation d'eau (12, V2; 202, 204) pour fournir de l'eau à la chambre (10, 200) et des moyens de commande (100, 232) pour commander automatiquement les moyens d'alimentation d'eau de manière à remplir la chambre (10, 200) jusqu'au niveau (W).

3. Dispositif selon la revendication 2, caractérisé en ce que les moyens de commande (100) commandent les moyens d'alimentation d'eau (12, V2) pour qu'ils fournissent de l'eau à la chambre pendant une période de temps prédéterminée de façon que la chambre (10) soit remplie jusqu'au niveau (W).

4. Dispositif selon la revendication 2, caractérisé en ce que les moyens d'alimentation d'eau comprennent un réservoir (202) relié à la chambre (200) pour fournir de l'eau à celle-ci, et en ce que les moyens de commande comprennent une soupape (232) pour commander l'alimentation d'eau du réservoir (202) vers la chambre (200), la soupape (232) étant montée de manière à s'ouvrir sous l'action d'un mouvement momentané du rotor (224), et à se fermer en fonction du niveau d'eau dans la chambre (200).

5. Dispositif selon la revendication 4, caractérisé en ce que la soupape (232) est disposée de manière à venir en contact avec les moyens de palettes (228) pour s'ouvrir ainsi sous l'action du mouvement momentané du rotor (224), et se trouve en outre disposée de manière à flotter sur l'eau contenue dans la chambre (200) pour se fermer ainsi en réponse au niveau d'eau.

6. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend des moyens d'alimentation en produit concentré (16, 214) pour fournir un arôme concentré, et des moyens (64, V3; 222, 286) pour décharger le produit concentré provenant des moyens d'alimentation en produit concentré (16, 214) de manière à le mélanger à l'eau carbonatée.

7. Dispositif selon la revendication 6, caractérisé en ce que les moyens (V3, 64; 286, 222) pour décharger le produit concentré peuvent fonctionner pour fournir du gaz carbonique aux moyens d'alimentation en produit concentré (16, 214) de manière à produire cette distribution du produit concentré.

8. Dispositif selon la revendication 7, caractérisé en ce que les moyens (64, V3; 222, 286) pour décharger le produit concentré peuvent fonctionner pour obtenir du gaz carbonique provenant de la chambre de gazéification (10, 200) de manière à le fournir aux moyens d'alimentation en produit concentré (16, 214) après la fin d'une opération de saturation à gaz carbonique.

9. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que l'axe du rotor (32, 224) est essentiellement horizontal.

10. Dispositif selon la revendication 9, dépendant de l'une quelconque des revendications 2 à 5, caractérisé en ce que l'axe du rotor (32, 221) est situé au-dessous du niveau (W).

11. Dispositif selon l'une quelconque des revendications 9 et 10, caractérisé en ce que si D est le diamètre du cercle balayé par le bout des palettes lorsqu'on fait tourner le rotor, et si L est la longueur de la partie des palettes dépassant au-dessus du niveau d'eau (W) lorsque le rotor est immobile, lorsque les palettes sont dans leur position haute maximum et lorsque l'appareil est horizontal, L représente alors au moins 5% de D.

12. Dispositif selon la revendication 11, caractérisé en ce que L représente au moins 12% de D.

13. Dispositif selon la revendication 11, caractérisé en ce que L est compris entre 12% et 15% de D.

14. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que celui-ci comprend un certain nombre de palettes (38, 228).

15. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend des moyens (100, 400) pour faire varier le temps pendant lequel les moyens d'entraîne-

ment (36, 230) sont actionnés, de manière à faire varier le degré de saturation à gaz carbonique obtenu.

16. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend des moyens (100, 400) pour stopper automatiquement le fonctionnement des moyens d'entraînement (36, 230) au bout d'un temps prédéterminé.

17. Dispositif selon la revendication 16, caractérisé en ce qu'il comprend des moyens d'arrêt manoeuvrables manuellement (404) pour stopper le fonctionnement des moyens d'entraînement (36, 230) avant la fin du temps prédéterminé.

18. Dispositif selon la revendication 16, caractérisé en ce qu'il comprend des moyens (106) pour sélectionner l'un de plusieurs temps prédéterminés différents, de manière à sélectionner le degré de saturation à gaz carbonique obtenu.

19. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend des moyens (44, 290) pour commander la pression du gaz carbonique dans l'espace situé au-dessus de l'eau, de façon que cette pression se situe dans une plage de 4,1 bars (60 psig) à 9,6 bars (140 psig).

20. Dispositif selon la revendication 19, caractérisé en ce que les moyens de commande de pression (44, 290) peuvent fonctionner pour maintenir la pression à environ 6,8 bars (100 psig).

21. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que le fonctionnement des moyens d'entraînement (36, 230) pendant une période de temps ne dépassant pas cinq secondes, permet d'obtenir la saturation à gaz carbonique.

22. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que les moyens d'entraînement (36, 230) peuvent fonctionner pour faire tourner le rotor (32, 224) à au moins 1000 tours par minute.

23. Dispositif selon la revendication 22, caractérisé en ce que les moyens d'entraînement (36, 230) peuvent fonctionner pour faire tourner le rotor (32, 224) entre 1000 et 1500 tours par minute.

24. Dispositif selon l'une quelconque des revendications 1 à 21, caractérisé en ce que les moyens d'entraînement (36, 230) peuvent fonctionner pour faire tourner le rotor (32, 224) entre 500 et 2000 tours par minute.

25. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que la chambre de saturation à gaz carbonique (10, 200) ne contient pas plus d'environ 1 litre (environ 8 onces de fluide) lorsqu'elle est remplie jusqu'au niveau (W).

26. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que la chambre (10, 200) est remplie jusqu'à environ cinq sixièmes de sa capacité lorsqu'elle est remplie jusqu'au niveau (W).

27. Dispositif selon l'une quelconque des revendications 2 à 5 ou selon l'une quelconque des revendications dépendant de celles-ci, caractérisé en ce qu'il comprend des moyens de commande de cycle (100, 400) pouvant fonctionner en réponse à un signal de démarrage pour faire effectuer au dispositif un cycle de saturation à gaz carbonique dans lequel les moyens d'alimentation d'eau (12, V2; 202, 204) fournissent de l'eau pour remplir la chambre (10, 200) jusqu'au niveau prédéterminé (W) tandis que cette chambre (10, 200) est décompressée, puis ensuite pour faire fonctionner les moyens d'alimentation en gaz carbonique (14, 206) de manière à fournir du gaz carbonique à la chambre (10, 200) pour remplir le volume sous pression élevée, les moyens de commande de cycle (100, 400) faisant également fonctionner les moyens d'entraînement (36, 230) pour faire tourner le rotor (32, 224) à sa vitesse permettant d'effectuer la saturation à gaz carbonique.

28. Dispositif selon la revendication 27, caractérisé en ce que les moyens de commande de cycle (100, 400) font fonctionner les moyens d'entraînement (36, 230) pour démarrer la saturation à gaz carbonique après que le volume ait été rempli de gaz carbonique jusqu'à la pression élevée voulue.

29. Dispositif selon l'une quelconque des revendications 6 à 8 et selon la revendication 28, caractérisé en ce que les moyens de commande de cycle (100, 400) peuvent en outre fonctionner pour actionner les moyens (64, V3; 222, 286) destinés à décharger le produit concentré après la fin de la saturation à gaz carbonique.

30. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que le rotor (32, 224) est monté excentriquement dans la chambre de saturation à gaz carbonique (10, 200).

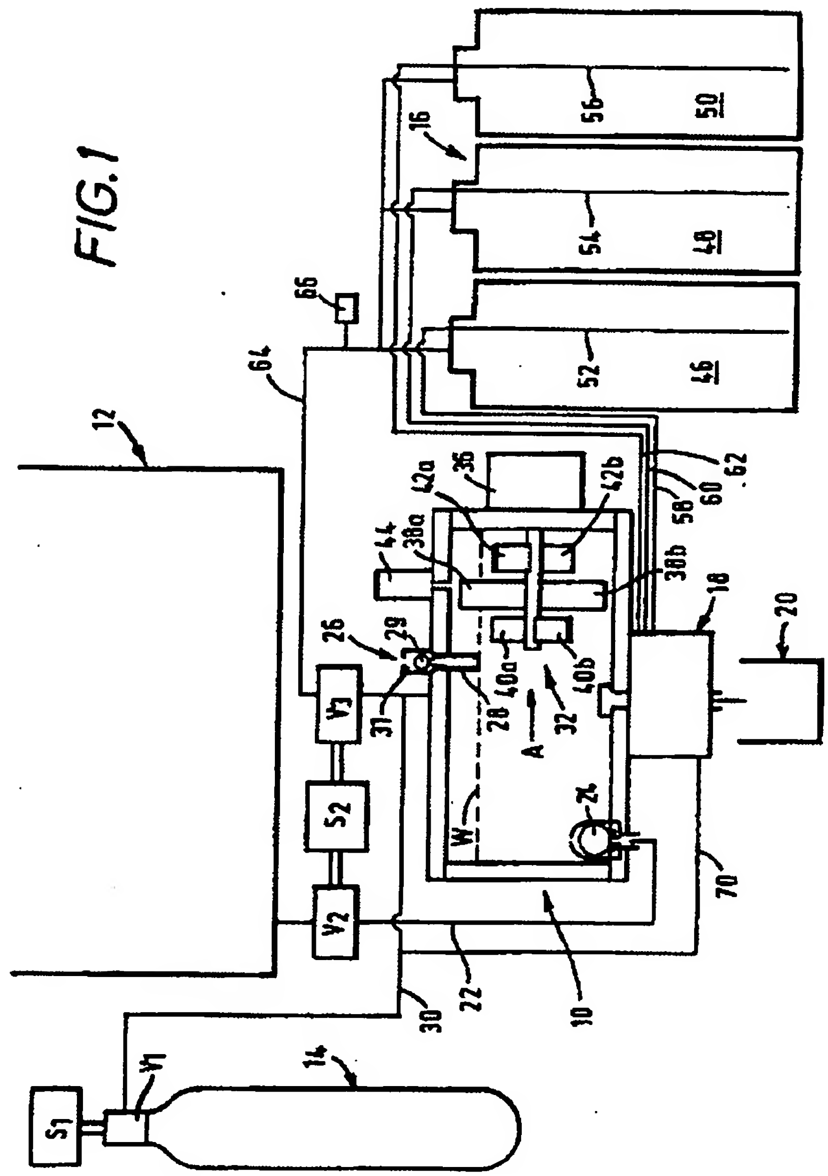


FIG.1

FIG.2

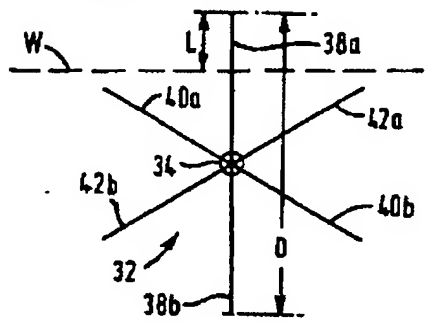
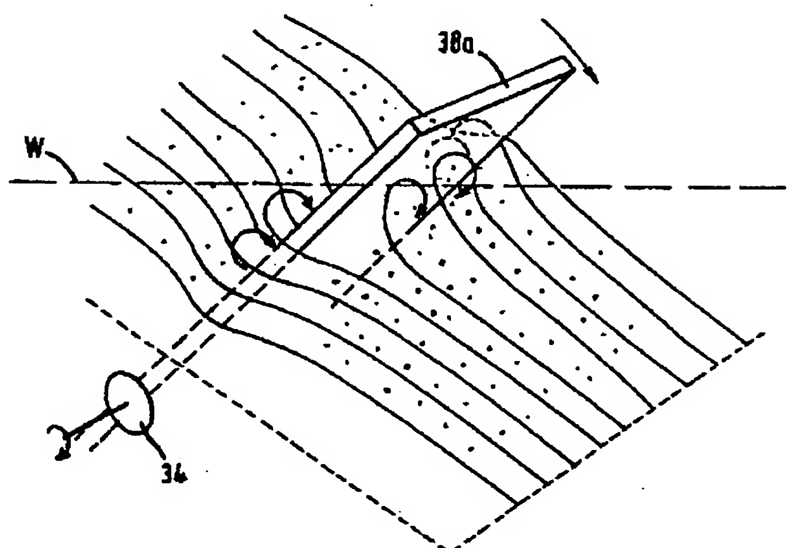


FIG.3



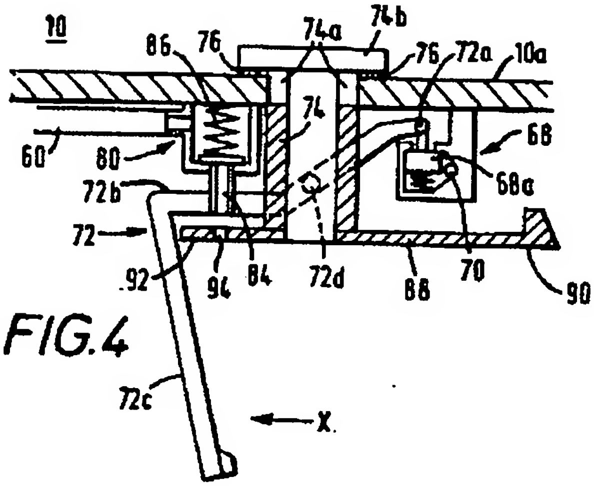

10
86
76
74a
74b
76
72a
10a
74
68
60
80
68a
72b
72
92
94
84
72d
88
70
90
72c
X

FIG.4

FIG.5

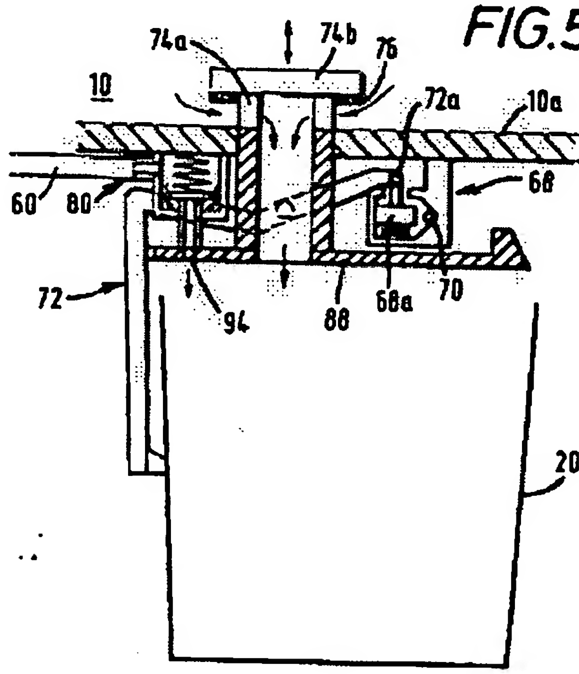

74a
74b
76
10
72a
10a
60
80
68
72
94
88
68a
70
20

FIG.6

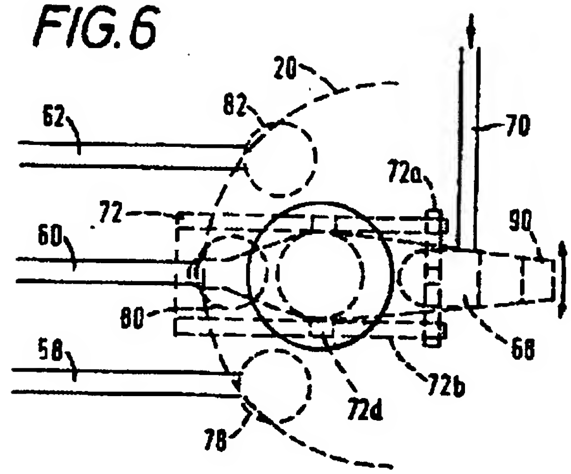

20
82
62
70
72a
72
90
60
80
68
58
72b
72d
78

FIG.7

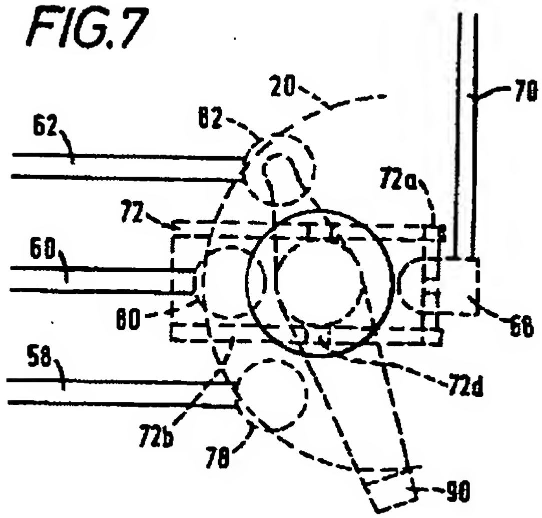
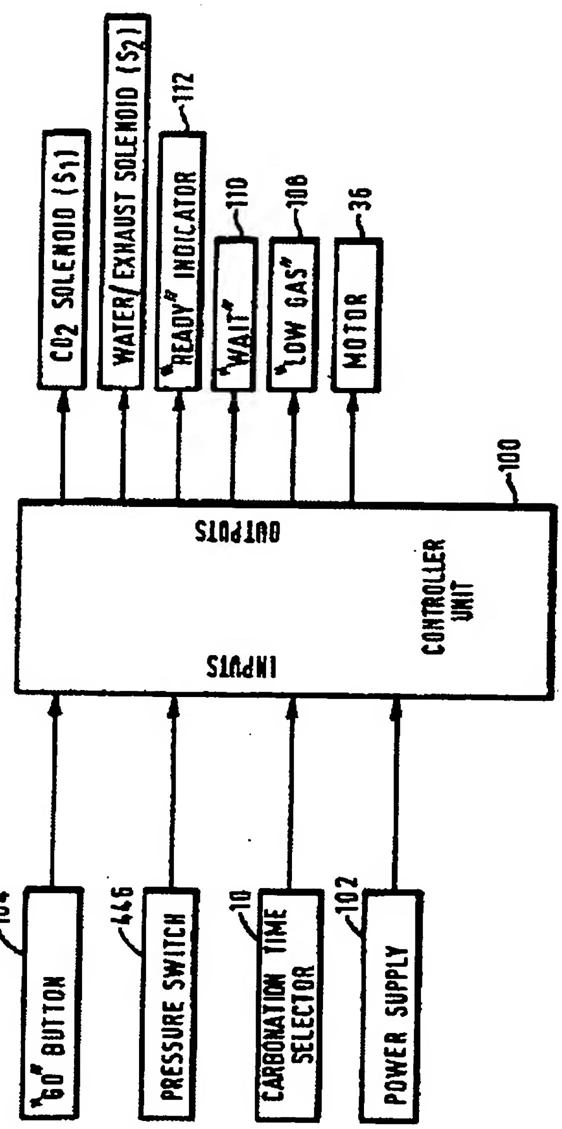

20
70
82
62
72a
72
60
80
68
58
72d
72b
78
90

FIG.8


CO2 SOLENOID (S1)
WATER/EXHAUST SOLENOID (S2)
"READY" INDICATOR
112
"WAIT"
110
"LOW GAS"
108
MOTOR
36
OUTPUTS
INPUTS
CONTROLLER UNIT
100
"GO" BUTTON
104
PRESSURE SWITCH
446
CARBONATION TIME SELECTOR
10
POWER SUPPLY
102

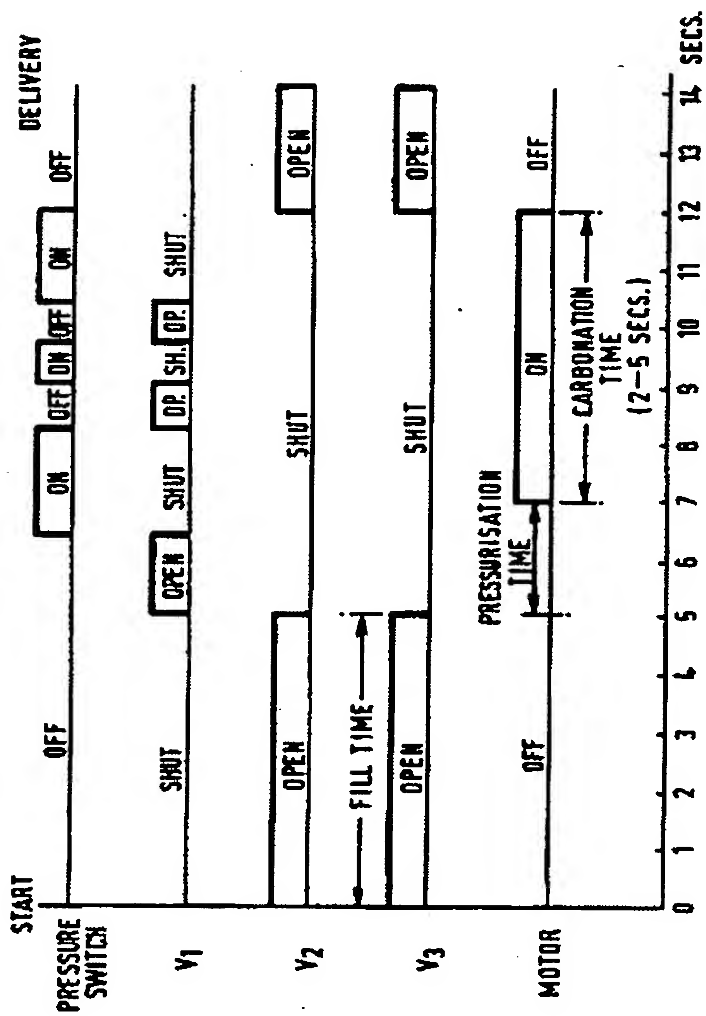

START
DELIVERY
PRESSURE SWITCH
V_1
V_2
V_3
MOTOR
OFF
ON
OFF
ON
OFF
ON
OFF
SHUT
OPEN
SHUT
OP.
SH.
OP.
SHUT
OPEN
SHUT
OPEN
FILL TIME
OPEN
SHUT
OPEN
OFF
PRESSURISATION TIME
ON
CARBONATION TIME (2–5 SECS.)
OFF
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
SECS.

FIG. 9

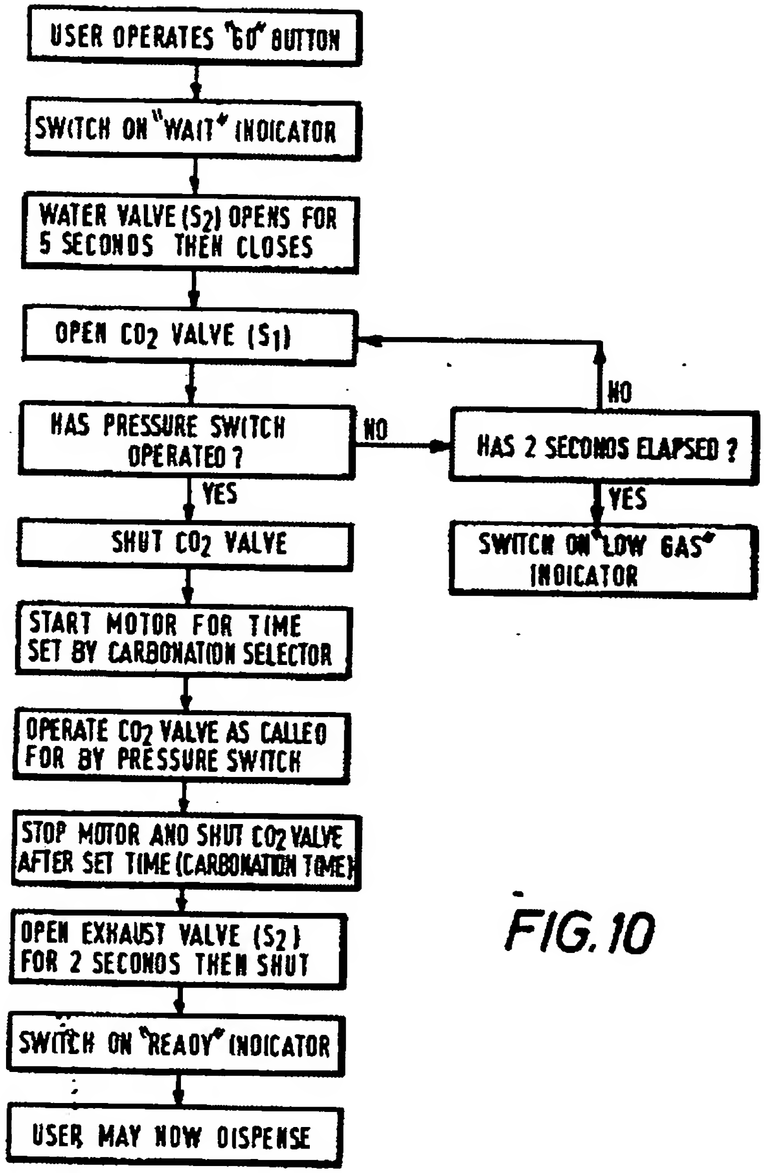

USER OPERATES "GO" BUTTON
SWITCH ON "WAIT" INDICATOR
WATER VALVE (S2) OPENS FOR 5 SECONDS THEN CLOSES
OPEN CO2 VALVE (S1)
HAS PRESSURE SWITCH OPERATED ?
NO
HAS 2 SECONDS ELAPSED ?
NO
YES
SWITCH ON "LOW GAS" INDICATOR
YES
SHUT CO2 VALVE
START MOTOR FOR TIME SET BY CARBONATION SELECTOR
OPERATE CO2 VALVE AS CALLED FOR BY PRESSURE SWITCH
STOP MOTOR AND SHUT CO2 VALVE AFTER SET TIME (CARBONATION TIME)
OPEN EXHAUST VALVE (S2) FOR 2 SECONDS THEN SHUT
SWITCH ON "READY" INDICATOR
USER MAY NOW DISPENSE

FIG. 10

FIG.11

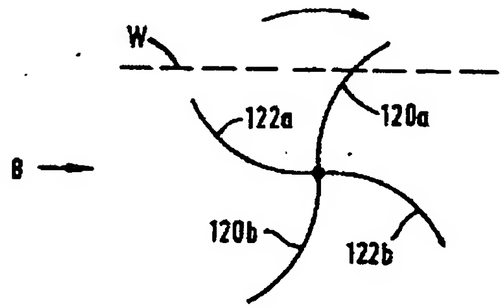
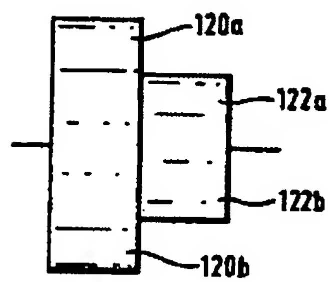


FIG.12



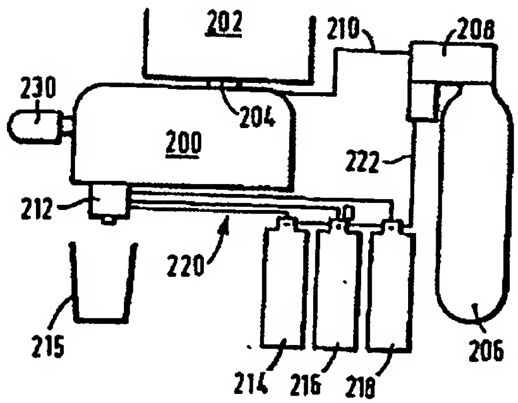
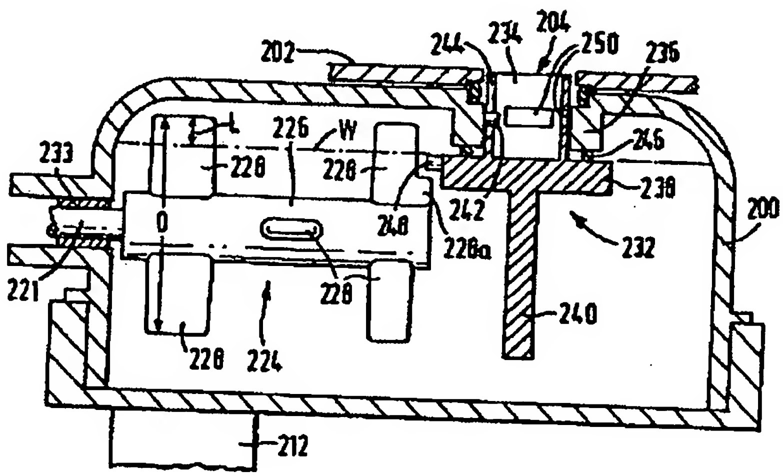


FIG.13

FIG.14



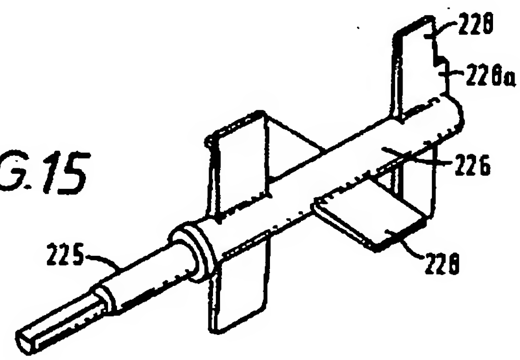


FIG.15

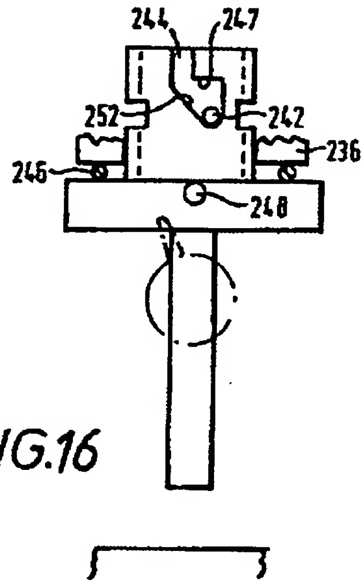


FIG.16

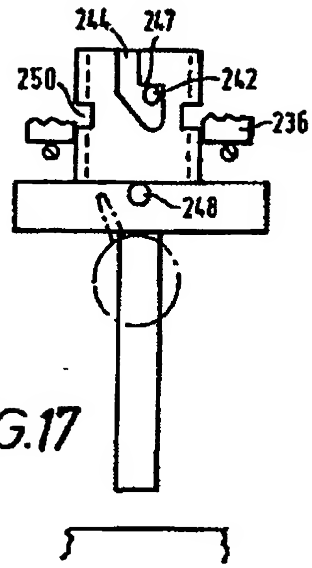


FIG.17

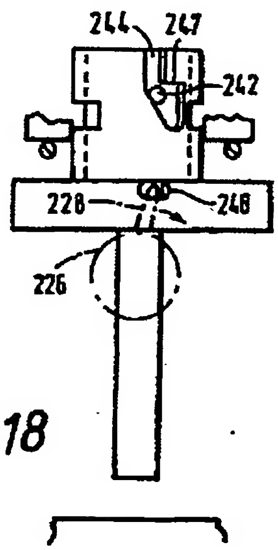


FIG.18

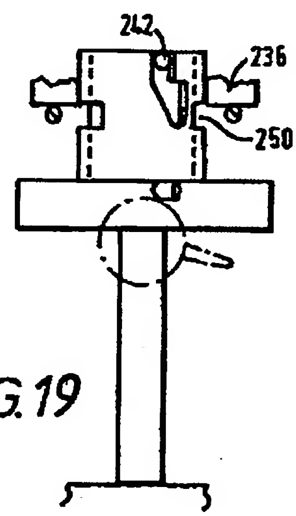
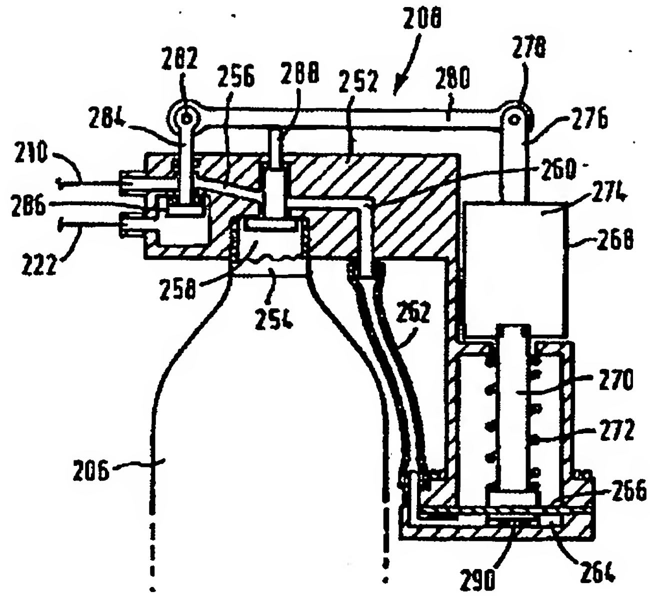


FIG.19

FIG. 20.


208
278
282
256
288
252
280
284
276
210
260
274
286
268
222
258
254
262
270
272
206
266
290
264

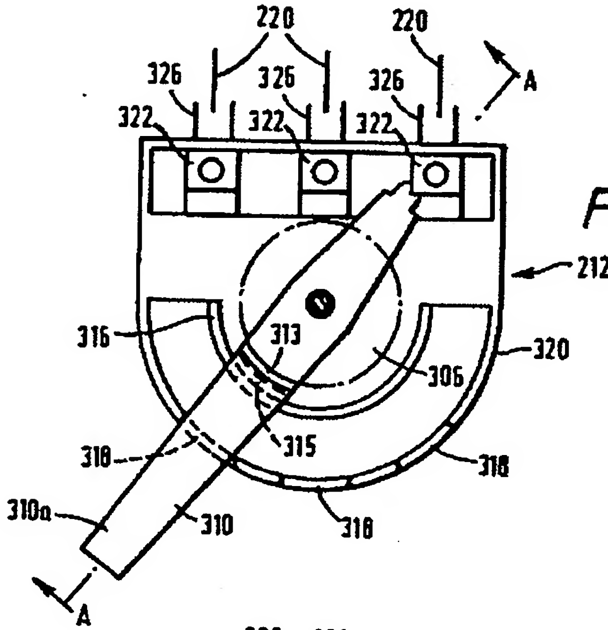


FIG.21

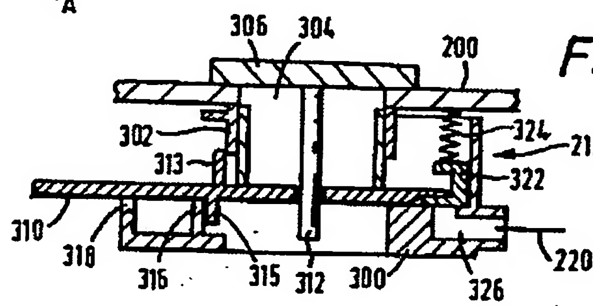


FIG.22

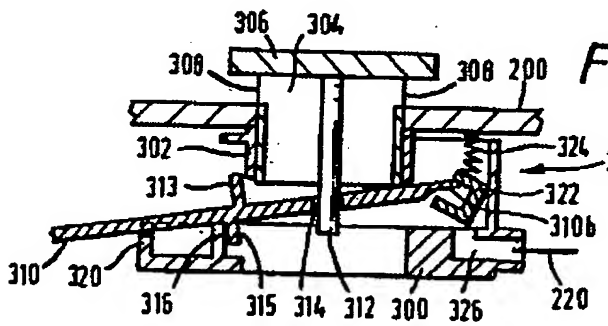


FIG.23

FIG.24

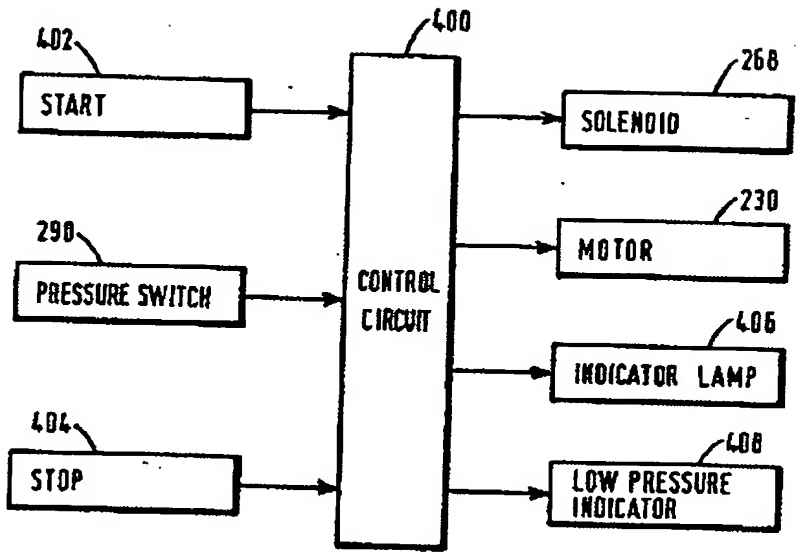
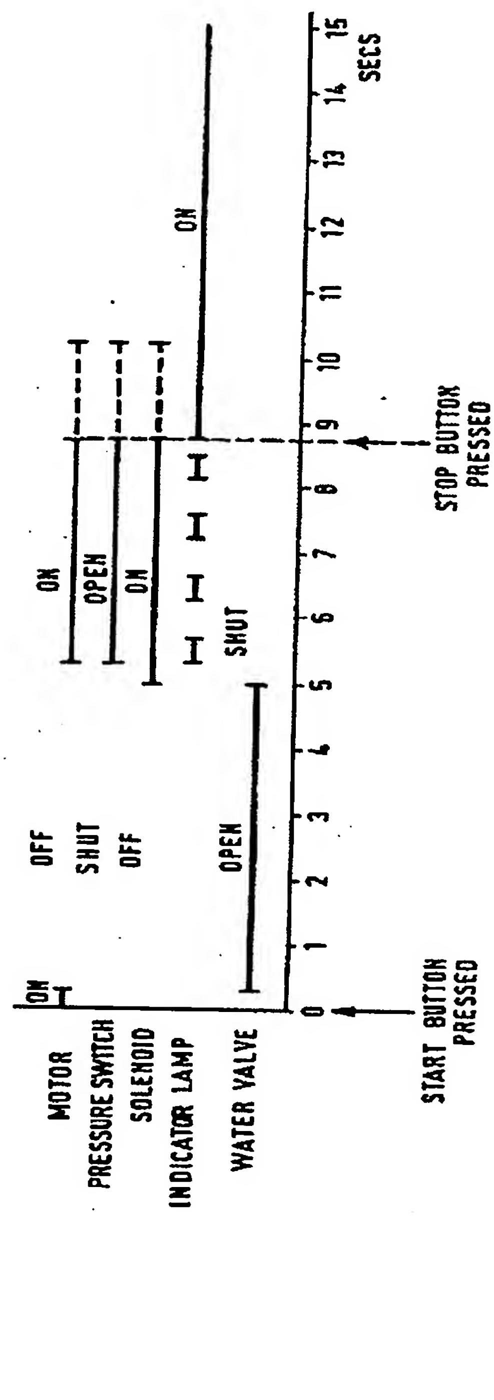

402
START
298
PRESSURE SWITCH
404
STOP
400
CONTROL
CIRCUIT
268
SOLENOID
230
MOTOR
406
INDICATOR LAMP
408
LOW PRESSURE
INDICATOR

FIG. 25


MOTOR
PRESSURE SWITCH
SOLENOID
INDICATOR LAMP
WATER VALVE
ON
OFF
SHUT
OFF
OPEN
ON
OPEN
ON
SHUT
ON
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
SECS
START BUTTON PRESSED
STOP BUTTON PRESSED